The Mechelectiv

VOLUME 26 MAY—1968 No. 6

THE GEORGE WASHINGTON UNIVERSITY

MAY 1968

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Move people through rush hours at 80 mph. Westinghouse built the experimental transit expressway in Pittsburgh. And we are building the computerized controls for the San Francisco mass-transit system that will be the model for others throughout America. We're looking for people to help us build equipment that will move people as they've never been moved before.

These graduates needed: Engineering, Physical Sciences, Social Sciences, Engineering Administration, Industrial Technology, Business & Liberal Arts.

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These graduates needed: Electrical Engineering, Mechanical Engineering, Industrial Engineering, Chemical Engineering, Engineering Mechanics, Marine Engineering, Structural Engineering, Ceramics, Nuclear Engineering, Materials Science, Physical Sciences.

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Westinghouse has 73 water-desalting units operating or on order around the world. Now we need people to help us design and build facilities that can desalt 150 million gallons a day—and solve some of the toughest water-supply problems we've ever tackled.

These graduates needed: Electrical Engineering, Chemical Engineering, Materials Science, Physical Sciences, Industrial Engineering, Engineering Mechanics, Mechanical Engineering, Civil Engineering.

Take a dive and explore the ocean 20,000 feet down. Westinghouse is developing a fleet of self-propelled undersea vehicles. In them we will dive deep, explore, salvage and probably discover more than any other single company in oceanography. We need adventurers to join the quest that has already taken us all over the world.

These graduates needed: Electrical Engineering, Mechanical Engineering, Chemical Engineering, Materials Science, Marine Engineering, Ocean Engineering & Science.

Build a city from scratch—the way a city should be built.

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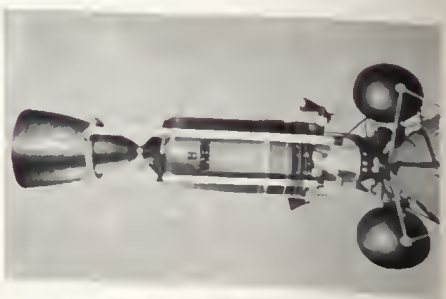

These graduates needed: Electrical Engineering, Mechanical Engineering, Chemical Engineering, Materials Science, Nuclear Engineering, Aerospace Engineering, Physical Sciences.

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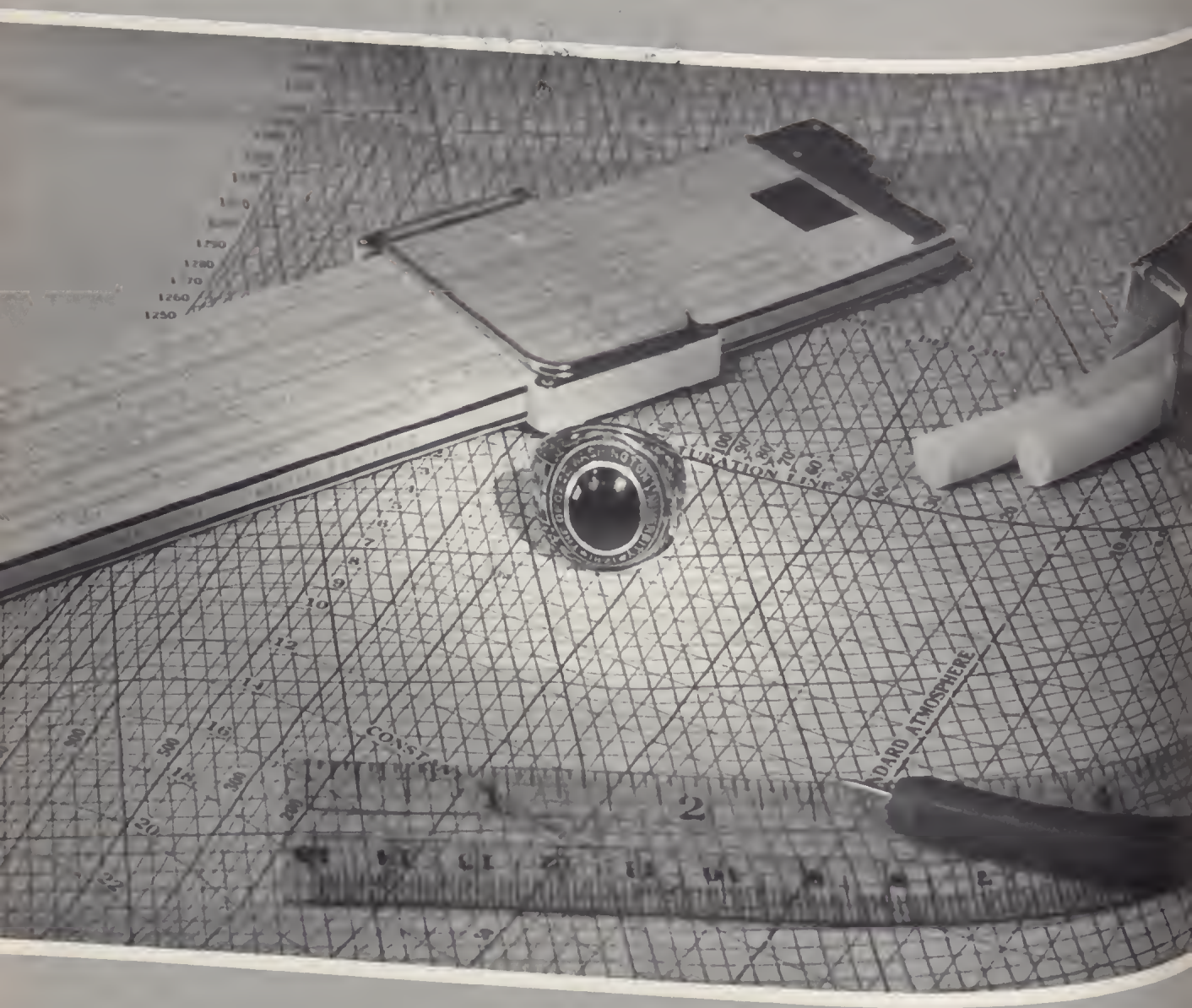
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SCHEDULING REVISIONS

In the last year the School of Engineering and Applied Science has undergone a face lifting which covers practically every aspect of the school. First came the curriculum changes: continuity of programs within the various majors, 130 instead of 140, credit hours required for graduation, and a mandatory 18 hours of electives in the Humanities or Social Sciences. Next came a revamping of the departments, returning to the familiar scheme of three departments with one chairman per department. Finally came a new dean of international stature who has committed himself to the task of transforming S.E.A.S. into a "little M.I.T." and then to "a great S.E.A.S."

Although the administration deserves a great deal of credit for the advances already taken, there still remain some aspects of the curriculum which are of great concern to the full-time students. The first is the area of course scheduling.

Under the present system, the administration is seeking to satisfy both full-time and part-time students by scheduling classes at odd hours during the day. Full-time students, usually referred to as day students, are forced to take many required courses during the evening so that these courses may also be available to the part-time, night students. At the same time many of the night students are forced to sacrifice work time to come to Tompkins to attend classes during the day. As can easily be seen the present system of class scheduling is neither satisfactory nor advantageous to either the full-time or part-time student.

The obvious solution to the problem would be to schedule both evening and day sections of the various courses. However, this is not always possible because of monetary reasons and teaching loads. In any case, it would be a short term solution to the problem. A better solution is for the administration to set up a long-range scheduling of courses to inform the night students what will be taught and when. By doing this the night students can decide the best road to follow in going for a degree. This long-range schedule should be constructed with the needs of the present students in mind, and make available those courses which will benefit the most people. In proceeding in this fashion you could get a majority of the students on the same schedule, and then the separate sections would be monetarily feasible. This is the same idea as establishing a course program specifically for the night students. In following this suggestion more full and part-time students could be attracted to the curriculum and the school.

Another area where reforms are needed is the scheduling of final exams. At the present time junior and senior undergraduate students find most of their exams bunched together during the last two or three days of the exam period. This is a little ridiculous! Seeing that these people are generally not taking courses outside of the S.E.A.S. a more acceptable schedule could be set up with no fear of conflicting exams. The situation is a little different with respect to the freshmen and sophomores. Most of their courses are in other schools of the university and must be reckoned with. Then again they are not taking that many engineering classes so the chance of conflicting exam times for this reason is slight.

In an attempt to refute the argument against the present method of scheduling exams, two points may be brought out. First, it is almost always possible for the individual classes to change exam dates and times. However, if just one person opposes a change for any reason the professor is forced to leave it as scheduled, thus defeating any possibility of change. Secondly, the examination period is going to be changed within the next couple of years so why bother now. The point is, why wait a couple of years? The changes are needed now!

If the reforms are made in the areas of class and exam scheduling, we will truly be on our way to becoming a great S.E.A.S.

the Mechelecivan

VOLUME 26 MAY—1968 No. 6

Page

ARTICLES

FEATURES

DEPARTMENTS

COVER

Inside view of a Saltz designed air filter.

FRONTISPIECE

Some of the necessary ingredients in studying for finals and preparing for the next semester.

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LETTERS TO THE EDITOR

Dear Editor:

I am submitting some ideas I have had concerning your editorial on Laboratories. I hope you can find room for them in your April issue.

I read with interest your editorial "Laboratories in Review" in the March 1968 issue of Mecheleciv, and would like to congratulate you for the concern you have shown for a very important phase of the efforts of our School. Your otherwise excellent arguments, however, suffer from inaccuracies and omissions to the point that you may be giving a misleading picture of the situation. Let me point out a few inaccuracies:

1) The Engineering Council for Professional Development (ECPD) does not accredit a School but curricula.

2) There was no case of probationary accreditation by ECPD, but of reaccreditation.

3) Not all Laboratories were found deficient. On the contrary some of our Laboratories were found very good.

4) The primary reason of criticism (and not of probation) of our curricula was not as you say, the Laboratory situation. On the contrary no such criticism was made for the Electrical Engineering curriculum.

5) Your statement of Electrical Engineering "junk" being stored in a large room in the Mechanical Engineering lab is grossly inaccurate. Your article, although it discusses the Mechanical and Civil Engineering Laboratories, is written in such a vein as to encompass the whole School. I believe this gives a distorted picture. I understand that in order to emphasize the point you are trying to make, you chose to concentrate primarily on weaknesses. Don't you think however, that by so doing you may do a disservice to the School? I see no mention in your article of the Electronics and Communications Laboratory, the Medical Engineering Laboratories, the Computer Laboratory, the Control and Projects Laboratory, the Electronic Equipment Repair Room, the Machine Shop. I believe that a rather obvious improvement has been achieved in these areas in the past two years. This achievement was made possible by initiative and hard and productive work from the part of both the students and faculty working together.

But enough of the weaknesses of your article. I started out congratulating you. I believe many other points you make are quite valid. The Laboratories in our School represent an area of concern to all of us: as you say, the students, the faculty and the administration. Although improvements have been made, we should not relax our attention, efforts and imagination to make even more valuable as tools to Engineering Education.

/s/Louis de Pian

Your statement is correct in saying that ECPD does not accredit a school but a curricula. It is also true that the curricula were reaccredited, but it was only for two years instead of four years. However, an error was made because there exists no probationary accreditation.

With regard to the statement concerning the Electrical Engineering equipment, the administration may not think that the M.E. Laboratory is a storage room for this "junk", but it has turned into a storage room.

The editorial was written with reference to the M.E. and C.E. Laboratories and was printed to point out their weaknesses. It was not meant to discredit the school in any way but to improve it.—Ed.

ECMA CONVENTION

by John C. Davies, III

It is 1968, the year of the national conventions. Although many people wait until the summer months to hold their conventions, one major convention has already taken place, the ECMA National Convention. The obvious question is now asked, what is ECMA? ECMA means Engineering College Magazines Associated. MECHELECIV and some fifty other magazines belong to this association, the purpose of which is "to promote the improvement of Engineering college journalism, to standardize size and format, and to simplify the soliciting and distributing of national advertising."

Each year ECMA holds a national convention. The purpose of these conventions caused much concern among the delegates who attended this year's New York meeting. Most of the delegates held to the idea that conventions should be one big party in which the staff members of the various magazines throughout the country are rewarded for their "hard" work during the past school year. The other division in the organization maintains that the annual convention is a chance for the various magazines to send representatives to a city or campus of a member school to relate the problems they are facing in putting out their magazine, and to listen to lectures on the lay-out and production of a magazine. Although these ideas on convention format seem to be 180 degrees apart, many delegates were able to perform the ideals of each faction.

This year's convention was not exclusively the party type. Several days were filled with listening to lectures, attending meetings, and holding "informal discussion groups." The nights were left open to the delegates. New York City's night life is not the dullest in the world, so that the ambitious student could fulfill his party obligations without hampering his style at the meetings during the day.

The selection of the convention site is a main factor in deciding which type a convention is to be. One can easily see what would happen if the convention were held in say Palm Springs. Who makes the decision on the site of the convention? As it stands now the Executive Committee, the Presiding Officers made up of students and faculty, has read into the constitution that they have the power to choose the location of the convention. Since the site has to be in a city in which a member school is located, and since this member school is automatically given a two year membership on the Executive Committee, the departing Executive members can actually appoint half of their student successors. This fact was not even brought out at the last convention. The long range result may be that some future Executive Committee favoring the nonengineer faction in the ECMA may eliminate the engineers altogether. Perhaps someone should reexamine this ruling before ECMA becomes CMA.

It would seem that nothing more than the selection of next year's convention site was accomplished. A quick examination of a typical business meeting should explain why:

DELEGATE: I move that we take a break for dinner. This meeting has been going on for four hours.

CHAIR: We have a motion. Is there a second?

DELEGATE: Cincinnati seconds.

CHAIR: Any discussion?

DELEGATE: Just because one person is hungry that does not imply that the rest of us are.

DELEGATE: The food here at the hotel is excellent and this is an important factor to be considered.

DELEGATE: I move that this motion be changed to a break for drinks.

DELEGATE: Cincinnati seconds.

DELEGATE: Point of order. There is already a motion on the floor.

CHAIR: Would the delegate like to change this to an amendment.

DELEGATE: Yes.

DELEGATE: Cincinnati seconds.

CHAIR: Is there any discussion on the amendment?

DELEGATE: I call the question.

DELEGATE: Cincinnati seconds.

CHAIR: The question has been called and we shall vote.

DELEGATE: I would like a roll call vote.

DELEGATE: Cincinnati seconds.

. . . . . two hours later

CHAIR: The amendment has been defeated, and now discussion is open on the original motion. Will the secretary please read the original motion.

SECRETARY: I forgot to write it down and the tape recorder broke 45 minutes ago.

CHAIR: Let's go eat and maybe we can think of it after dinner.

Although the convention that took place in New York City may have seemed to be a failure, a great deal was learned. If you would like the opportunity to learn more, join the MECHELECIV staff.

Note: The Convention for this coming year might be in Miami.

MECH MISS

Lynne Pace

This month's Mech Miss is Miss Lynne Pace, a 21 year-old American Thought and Civilization Major. Since transferring to G.W. from Ryder College, Lynne has participated in the Political Affairs Society, Kappa Kappa Gamma Sorority, Dorm Council, Miss Model Pledge contest, and has been an Engineering Princess.

Outside G.W. Lynne's activities include canoeing and sailing. It is interesting to note that the computer paired Lynne with Assistant Professor Jones as an ideal date.

Here's hoping that everyone can find his own Pace and hold it.

CAMPUS NEWS

Theta Tau Holds Second Annual Auto Rally

Alan Dohne with his wife Carol as navigator drove the winning car in Theta Tau's Second Annual Auto Rally. The rally, held April 21st, started at 23rd & G Street and covered about 80 miles, mainly in Montgomery County. Stacy Deming was rally master with the other brothers of Theta Tau manning four checkpoints. Seventeen cars started the rally, which took about three hours to cover. John Huffman with his brother Mark as navigator were second place winners. The team of Klein and Lang were third.

GRADUATING SENIORS

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

Berg, David Winston
Castle, Joseph Edward
Dove, Robert Ellsworth
Goldstein, Burton
Grefe, Terry Don
Harris, Jr., James Robert
Neuffer, Bruce Robert
Riva, Antonio Jesus

BACHELOR OF SCIENCE (ELECTRICAL ENGINEERING)

Bissell, Jr., John Arthur
Blumberg, Richard Jay
Cavanaugh, John Timothy
Deming, Andrew Stacy
Enger, Thomas Arthur
Hunt, Ralph Waesche
Klare, Stephen Warren
Kopeck, Ronald Frank
Kuhn, Jr., Harry A.
Laurenson, Michael B.

BACHELOR OF SCIENCE—CONTINUED

Fadlaoui, Abdelaziz
Foote, Kenneth Glen
Friedlander, Jan Eliot
Gage, Jr., Francis Howard
Herman, William Arthur
Miller, Charles David
O'Byrne, Joseph William
Smith, Frederick Lorenze
Stix, Thomas George

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

Austin, Peter Montague
Barton, Jr., Richard Effinger
Bonhomme, Ernst
Carroll, Gerard Peter
Hum, Spencer Alan
Lewis, Terrell Paul
Tsamisis, John Carl

HOLOGRAPHY — THE SCIENCE OF "WHOLE" PICTURES

by John Bissell

Although only 20 years old, this new science or possibly art, referred to as holography has and will lead to many innovations in fields ranging from simple photography to crime prevention and even medicine. Basically, the hologram is a photograph, much the same as photographic slides, but one in which the viewer, by observing the film from different angles, can see different views of the object. Thus, the hologram is a three-dimensional reproduction of an object, but on a two-dimensional piece of film. Fascinating as well as promising!

First produced about 20 years ago when a physicist named Dennis Gabar at London's Imperial College of Science and Technology tried to photograph an interference pattern caused by light from a mercury-vapor lamp, the advent of the high intensity coherent light of the laser has opened the door to the full-fledged research into the field of holography which is being carried on today.

In order to understand how the 3D effect of the hologram is produced on film, it must be explained how the film is exposed in the first place. Using a laser beam as a light source, the beam is first sent through a prism which splits the beam, directing half at the object being photographed and the other half directly at the unexposed film. While that half of the beam which strikes the film directly (called the reference beam) is unobstructed and, therefore, still coherent, the beam reflected from the object (called the object beam) is no longer coherent and thus, out of phase with the reference beam. When the various crests and troughs of both beams strike the film, an extremely complex interference pattern is produced, which when viewed in ordinary light resembles, not the original object, but a pattern similar to the ripples caused by numerous raindrops on a smooth pond. It is only when the back of the developed film is again illuminated by another high intensity laser beam that the interference pattern on the film is able to separate the light into the pattern which originally fell on the film and thereby recreate the image on the film.

Because every bend, curve, edge and indeed every physical feature of the object reflects light in its own particular manner, the interference pattern produced on the film will be entirely different in every part of the film. It is this principle which allows the hologram to reproduce a three-dimensional image rather than the two-dimensional image produced by a regular camera which must use a lens to focus nearly parallel light waves from an object to create a flat image on a piece of film.

Aside from three-dimensionality, holograms also exhibit other qualities which are the results of this interference pattern method of image reproduction. Since it is unnecessary to use a lens to create the image on film, every part of the object or the display being photographed appears in perfect focus, those objects in the background being just as clear and sharp as those up front.

Also, even if holograms are cut into sections, the interference pattern on each section will still reproduce the entire object or scene but with decreased clarity and angle of reference through which the object appears.

Since a hologram is nothing more than an interference pattern, it would seem that it might be possible to reconstruct the interference patterns of various objects using a computer, and in fact this has been done. Engineers at General Motors have programmed their computers to plot the interference patterns produced by simple geometric shapes as well as a few letters of the alphabet. These patterns were then placed on film and illuminated by laser, producing the expected image although no object actually existed. The hope is that this technique will allow designers to observe the finished product long before it has actually been built, but this of course, will take a great deal of time and research.

Some of the recent developments in the field of holography have been the use of sound waves to produce an interference pattern which when placed in a laser beam again produces the image of the object reflecting the sound waves, colored holograms using lasers of the three primary colors for illumination of object during photographing and then for illumination of hologram in order to reproduce a colored image, and a method of viewing holograms in white light. But the most beneficial developments in holography have come in the fields of medical research. The American Optical Company is working on the development of a hologram microscope which will allow doctors to study objects as small as single cells three dimensionally, and the hope is that eventually, the hologram will allow doctors to view, three-dimensionally, bones and diseased parts of the heart, lungs, or any other part of a patient without the need for surgery.

The next 20 years promises even more!

Information for this article was obtained from *Scientific American*, February, 1967, *Popular Mechanics* March, 1968, *Science* August 26, 1966 and *Life* December 23, 1966.

If you want to rock the boat, it's fine with us.

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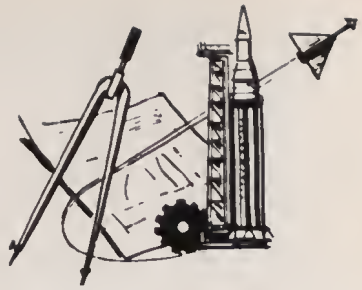


Edited by David Armstrong, E.E., 70

G.E. COMPUTERIZED STUDENT RESPONSE SYSTEM

A computerized Student Response System which will permit an instructor to simultaneously quiz up to 97 students and provide him with an instant feedback of their answers has been installed in an advanced teaching facility at Syracuse University.

Designed by the General Electric Research and Development Center, the response system, which consists of electronic panels located on the 97 desks in the classroom, allows an instructor to pose multiple-choice questions during the course of a lecture. The students' responses are immediately displayed on the instructor's console.

The system provides the instructor with a tool for measuring the effectiveness of his presentation — as he makes it. He knows whether to continue the pace and content of his lecture, or to backtrack and review previously presented material, or to accelerate the pace.

In addition, the student responses can be fed through telephone lines to Research and Development Center's GE-265 computer in Schenectady, New York, where they are analyzed and information about individual students performance is transmitted back to the instructor via teletype.

The 97 electronic response panels at Syracuse consist of six push-buttons — five which represent answers to multiple-choice questions, and a sixth which permits a student to "erase" a choice and change his response.

Computerized Student Response System

Desalination by Freezing

PURE ICE

In the above photo a column of pure ice glows brightly in a tube of salt water during a desalination experiment at the Westinghouse Research Laboratories. The glowing effect is caused by polarizing filters used to take the photo. Pointing to the surface of the ice where impure water builds up is Dr. R. G. Seidensticker, one of a group of Westinghouse scientists who are studying the process of desalting by freezing. Ice is grown at the bottom of the water so that upswelling currents do not complicate the experiment.

NEW FINDINGS SUPPORT CONCEPT OF CLOSED UNIVERSE

Ever since Einstein included in the foundation of his general theory of curved space the assumption that the physical space becomes curved in the neighborhood of large masses (the bigger the mass the larger the curvature) there has been much disagreement on whether the physical state of the universe is infinite or finite. At first, the idea of a finite universe suggests that if you go far enough into space you will inevitably encounter a blank wall. But space can be finite without being necessarily limited by a boundary. It can simply curve around and close on itself.

This is exactly what scientists at the Naval Research Laboratory say their new evidence supports. A rocket launched by N.R.L. last September detected a huge and unexpected amount of matter throughout space in the form of thinly-spread hydrogen gas. The vast amount of matter detected indicates that there is at least 100 times as much

Continued on Page 15

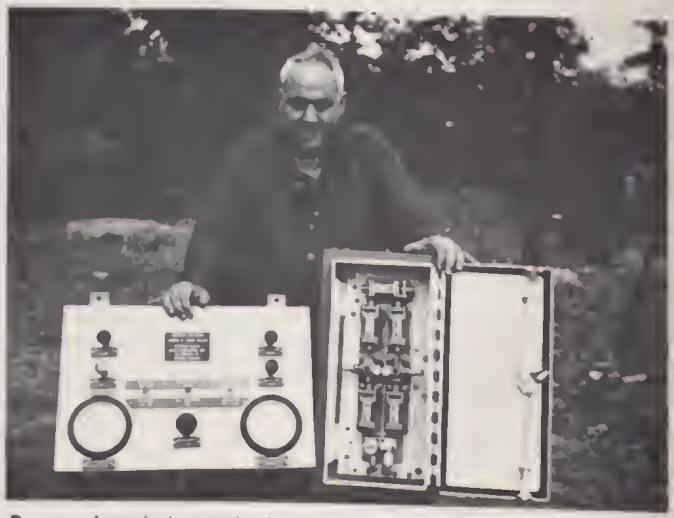
PNEUMATIC MACHINERY CONTROLS

by Clare Saltz

Mr. Clare Saltz graduated from the University of Michigan in 1942 with a BS in Chemical Engineering. During his wartime career in the Navy he rose to the rank of commander and became proficient in explosives. He is presently designing and building explosive-handling machinery for the Navy.

Until recently, compressed air was regarded simply as a power medium to push a piston in a cylinder. The most notable historical use was the invention by George Westinghouse, Jr. in 1869 of the air brake for trains. However, the use of air-powered controls is rapidly becoming the most important use of pressurized air.

The use of compressed air instrumentation is not entirely new, but a recent break-through has made it possible to design and build complete logic systems solely using 50 psi compressed air rather than the former system of varying air pressures for different functions. This type of machine control is not to be confused with "fluidics" which I consider still in its experimental stages, although it has received much publicity recently.



Pneumatic switches and relays provide a safe, reliable substitute for electrical components.

PNEUMATIC TIME DELAY

The most important recent development in this type of instrumentation is the pneumatic time delay. These controls employ a needle valve to regulate the rate at which a chamber fills to a preset pressure. Previously, a drop of lubrication oil could lodge in the gap in the seat of the needle valve and stay there due to capillary action. The effect was to change the shape of the orifice through which the air was passed thereby altering the flow. This made the time setting very unreliable. The technological break-through came when it became possible to manufacture an air-tight valve and spool assembly which required absolutely no lubrication. The lapping and fit of the hardened stainless steel parts are so accurate that the valve is lubricated by a molecular-thin film of air that is perfectly dry and oil-free. By timing with this dry air, it became possible to use needle valves with extremely close clearances between the needle and its valve seat.

The results are amazing! Pneumatic timers are available that are fully adjustable from 0 to 30 seconds with a repeatability tolerance of 1/100th of a second. We can build timers for fifteen minutes or more simply by externally adding to the volume chamber of the valve body. These non-lubricated valves are marketed today to perform relay functions with a proven life of 150 million cycles without a failure. Comparable electrical relays start to fail after one million cycles.

AN ELECTRO-MECHANICAL SYSTEM TO A PNEUMATIC SYSTEM

Four and one half years ago, I was commissioned by the Navy to design a solid propellant pneumatic transfer system to be remotely controlled from a blockhouse 350 feet distant. The transfer machine had the following automatic steps:

1. Clamp 6 fiber drums, each containing 150 lbs. of granular powder.
2. Tilt the row of drums 30°.
3. Extend suction probes slowly into the drums so that the powder is conveyed from the barrels to a third floor hopper.
4. When the probes reach bottom, vibrators start and oscillate for 45 seconds.
5. Shut off vibrators and rapidly retract the probes.
6. When the probes are fully retracted, tilt the row of drums back to level.
7. When level, open the clamps.

All these motions were to be completely automatic and monitored in the block house with visual signals on the block house control panel.

CONTINUED ON NEXT PAGE

PNEUMATIC CONTROLS—Continued

The above cycle was designed sequentially so that by the use of limit switches each successive step is initiated by the completion of the previous step. I planned to use explosion-proof electric limit switches to actuate solenoid valves that controlled three sets of double-acting air cylinders on the machine.

One factor plagued me — what if we should lose our electric power on the main suction exhausting while step 3 was in progress? Stopping the conveying air would cause settling and plug up the piping with a dangerous explosive! The Navy needed a "fail-safe" feature that would automatically disengage the suction probes the instant the electricity failed. The exhauster would have a chance to sweep the lines clean while it slowed to a stop. We decided to use our compressed air supply as a back-up system. When we worked it out, I realized that we did not need electric limits at all to operate the machine. Limit valves were substituted for limit switches and virtually all of our solenoid valves became unnecessary. We kept one solenoid valve in the system to solve our basic safety problem. This solenoid was connected to our motor control circuit so that when the motor was on, the valve was energized to close. Whenever the motor control was off, a spring opened the valve to activate the pneumatic suction probe reversing air circuit.

We built four transfer systems with a cost savings of $20,000 through the elimination of cumbersome explosion-proof electric construction. Compressed air is inherently explosion-proof, so that standard parts could be employed with ease. These compressed air systems can be made to operate under conditions that electrical wiring could never stand. They are corrosion-resistant and fire-resistant. When conditions exceed the deterioration point of plastic or electrical insulation, we simply use aluminum tubing, which is vermin-proof, corrosion-proof and spark-resistant.

Thus, pneumatic logic control circuits are being built today to control complex machines with safety and reliability that far exceeds that of electrical controls. One manufacturer boasts that his control system will outlast the machine for which it is built. The cost of these systems are directly competitive and in many cases much lower. The technical details of how this is accomplished are scattered in many texts and handbooks. A great deal of "know-how" is in the trade secret category. I have tried to show the scope of the applications. Specific details are properly the subject of another article.

NEW FINDINGS—Continued

matter between galaxies as there is in all the millions of stars put together.

Dr. Richard C. Henry, at the Naval Research Laboratory, stated that this new evidence has to mean that we live in a universe closed in on itself like a ball, rather than one reaching on and on forever through infinity. Dr. Henry also stated that if the average mass density of cosmic space is less than a critical value, the universe is open. If it is greater than the critical value the universe is closed. From the amount of matter detected, the universe has apparently turned out to be closed.

Up to now the existence of matter between galaxies has been supposed but never detected. Henry and his associates launched a low-energy X-ray detector aboard an Aerobee rocket, and thus detected the matter by detecting the radiation from it. Henry stated that the matter has visible radiation-light but that it was drowned out by the stars. Thus they used instruments which would detect radiation with very little competition-low energy X-rays. The instruments detected fiercely hot gas consisting almost entirely of protons and electrons, with protons accounting for most of the matter (hydrogen gas). There is enough thinly distributed matter, according to Dr. Henry, to fill up all space and satisfy all the theoretical requirements for a closed universe.

Dr. Henry also stated that a closed universe will someday collapse. An open universe would expand further, but a closed one will gradually slow its expansion to a stop due to gravitational drag of its great amount of matter. Every particle will attract every other particle until the expansion reverses and the universe finally falls inward and in the end condenses to one huge fireball. Dr. Henry predicted however, that this is at least 10 billion years away. (Information from *The Washington Post,* 4/18/68)

Note: For an interesting discussion of open and closed universes, see the book *One Two Three . . . Infinity* by George Gamow, former GWU physics professor.

HOLOGRAPHY OF DYNAMIC PHENOMENA

The figure below is a reconstruction of a double exposed hologram which three-dimensionally recorded the burning front of an acetylene-air mixture in a transparent Plexiglas cylinder, ignited by a miniature spark plug. The hologram, made at TRW Systems Group, Redondo Beach, California, was taken three milliseconds after detonation with a ruby laser using a pulse duration of 100 nanoseconds. It was the first time such a confined explosion has been interferometrically recorded, and points to the value of lenseless photography (holography) of dynamic phenomena as a research and engineering tool.

MORE ON HOLOGRAPHS PAGE 11

Hologram of a Confined Explosion

THE SHAFT

Since we call professors "profs", it is easy to figure out what we should call assistants.

* * *

Dean of Students: "I have a report here that coke, soda, and whiskey were found in your room. What do you make of that?"

Student: "Highballs, sir."

* * *

A lovely coed named Loretta
Loved wearing a very tight sweater.
Three reasons she had: Keeping warm wasn't bad
But the other two reasons were better.

* * *

Coed: "Who said you could kiss me?"

ME: "Everybody."

* * *

Then there was the ME who thought that steel wool was the fleece from a hydraulic ram.

* * *

She had a million-dollar figure, but the top half is counterfeit.

* * *

Dunk your donut in LSD and take a round trip.

EE: "May I kiss you?"

She: "Heavens! Another amateur!"

* * *

Lectures are like steers horns — a point here, a point there, and a lot of bull in between.

* * *

"Dear," he whispered, "Can't we leave marriage out of the picture. I mean . . . well, you're more like a sister to me."

"My God, what a home life you must have."

* * *

A fox is a guy who always gets what the wolf is after.

* * *

Prof: "Well, what did you think of the course?"

EE: "I thought it was very well covered. Everything that wasn't covered during the semester was covered on the final."

* * *

My girl and I had an argument last night. She didn't like the way I felt about her.

* * *

As they say in mechanics — "Every couple has its moment."

"Some girls are cold sober — others are always cold."

* * *

The eager relatives gathered for the reading of the will. It contained one sentence: "Being of sound mind, I spent every damn cent I had."

* * *

Never drink when you drive. You might hit a bump and spill the drink.

* * *

Student Nurse: "Isn't it funny that the length of a man's arm is just equal to the circumference of a girl's waist?"

EE: "Let's get a piece of string and find out."

* * *

At a dinner party a young engineer had been trying to think of something nice to say to his hostess. At last he saw his chance when she turned to him and remarked, "What a small appetite you have tonight, Tom."

"To sit next to you," he replied gallantly, "would cause any man to lose his appetite."

* * *

FAMOUS LAST WORDS: "Hell, he won't ask us that."

"I used to think IBM would be one of the last places for an M.E."

"I was skeptical about IBM as a place for a mechanical engineer to work. E.E.'s, sure. But M.E.'s?" (This is Dick Driscoll, B.S.M.E. '67, a Manufacturing Engineer at IBM.)

"I was wrong. There are plenty of opportunities for M.E.'s in just about all areas, especially in development and manufacturing.

"When I joined IBM, I chose manufacturing engineering. In my case, this got me involved in producing core planes for memory components. After the component has been designed, I coordinate the tooling and all the other manufacturing processes. I initiate basic ideas on the design of tooling and work closely with the machine tool and die designers and builders, and with the installers of the production machinery.

"It's sort of like solving a very difficult three-dimensional jigsaw puzzle. And it's a 'pure' engineering job. The kind I was trained for. Because, in the final analysis, product responsibility for manufacturing the memory component rests with one person. Me.

Interdisciplinary environment. "You get exposed to a lot of different disciplines in manufacturing engineering. Electronic. Metallurgical. Chemical. This kind of interfacing broadens you as an engineer.

"It may sound square, but I think IBM is a great place for an M.E. to work."

If you'd like to know more about a career in mechanical engineering with IBM, visit your campus placement office. Or send a brief outline of your educational background to Paul Koslow, IBM Corporation, Dept. E, 425 Park Avenue, New York, N.Y. 10022. We're an equal opportunity employer.

IBM®

Dan Johnson has a flair for making things.

Just ask a certain family in Marrakeck, Morocco.

A solar cooker he helped develop is now making life a little easier for them—in an area where electricity is practically unheard of.

The project was part of Dan's work with VITA (Volunteers for International Technical Assistance) which he helped found.

Dan's ideas have not always been so practical. Like the candlepowered boat he built at age 10.

But when Dan graduated as an electrical engineer from Cornell in 1955, it wasn't the future of candle-powered boats that brought him to General Electric. It was the variety of opportunity. He saw opportunities in more than 130 "small businesses" that make up General Electric. Together they make more than 200,000 different products.

At GE, Dan is working on the design for a remote control system for gas turbine powerplants. Some day it may enable his Moroccan friends to scrap their solar cooker.

Like Dan Johnson, you'll find opportunities at General Electric in R&D, design, production and technical marketing that match your qualifications and interests. Talk to our man when he visits your campus. Or write for career information to: General Electric Company, Room 801Z, 570 Lexington Avenue, New York, N. Y. 10022

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